is found to furnish a possible explanation of the controlled sex ratios.

Not only can the sex of pigeons be changed but it can also be accentuated. The females hatched from the second egg of the clutch, laid in the autumn by overworked birds, are more pronounced females than the normal females of the species. This is evidenced by the persistence of a right ovary in such birds. In normal female pigeons the right ovary has completely degenerated in the week-old squab.

The literature reviewed gives evidence of a relation between rate of metabolism and sex in a great variety of animals, varying from worms to man. With sex viewed as an expression of differentiated metabolic activity, its independent origin in diverse groups of organisms ceases to be a stumbling block, being no more remarkable than that the same color should have originated independently in different groups. The work reported is confined to the animal kingdom and it should be of interest to determine whether in dicœcious plants there is a corresponding differentiation in the rate of metabolic change.

Dr. Riddle's work would seem to call for discussion by those students of genetics who place the distribution of the chromosome in a causal relation to sex, since his results directly challenge this interpretation. It is shown that in some cases at least sex is determined before the segregation of the chromosomes, a fact which would seem to make chromosome number a characteristic rather than a cause of sex.

Furthermore, the challenge extends to all Mendelians, for if "one hereditary character (sex) is modifiable, is of a fluid, quantitative, reversible nature," surely the alternative nature and stability of other characters come in question.

It is worthy of note that all three investigators, though working in widely separated fields and approaching the problem of evolution from very different angles, conclude that evolutionary change is, in effect at least, a gradual process that is not beyond the power of man to man influence.

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## SPECIAL ARTICLES

### THE RÔLE OF CATALASE IN ACIDOSIS

IF an inorganic acid, such as hydrochloric, be administered to an animal, it is neutralized by the alkalies of the blood and tissues; if an organic acid be administered, it is oxidized, unless the oxidative processes of the animal are defective, as in diabetes, in which case the organic acids are neutralized, as are the inorganic. This neutralization of acids leads to a depletion of the "alkaline reserves" of the body, which produces the condition known as acidosis. By the term acidosis is meant the impoverishment of the tissues and blood in alkalies. In very severe cases of diabetes, the animal is not able to burn sugar and can burn fat and protein only as far as $\beta$-oxybutyric and diacetic acids and acetone, hence the tissues of the diabetic would become acid in reaction were it not for the fact that the acids formed in this disease are neutralized by the alkalies of the tissues. Since this neutralization leads to a depletion of the "alkaline reserves" of the body in severe cases of diabetes and since acidity of the tissues is incompatible with life, the animal dies. From the foregoing it is readily understood how the intravenous infusions of sodium bicarbonate are helpful in overcoming the coma of diabetes. Besides diabetes, it is known that acidosis occurs in "surgical shock," in anesthesia, and in starvation. It is also known that in these conditions oxidation is decreased and that the accumulation of the resulting incompletely oxidized substances, acid in nature, are responsible for the acidosis. The present investigation was carried out in an attempt to find an explanation for the decreased oxidation with resulting acidosis in the conditions mentioned.

*Diabetes.*—Pancreatic diabetes was produced in dogs by extirpating the pancreas. Sugar appeared in the urine a few hours after the operations. About two weeks later, when the animals were in a moribund condition, they were killed and the blood vessels were washed free of blood by the use of large quantities of 0.9 per cent. sodium chloride, as was indicated

by the fact that the wash water gave no test for catalase. The tissues were then removed and ground up separately in a hashing machine. The catalase of one gram of the different tissues was determined by adding this amount of material to 50 c.c. of hydrogen peroxide in a bottle at 22° C., and as the oxygen gas was liberated, it was conducted to an inverted, graduated vessel, previously filled with water. After the oxygen gas thus collected in ten minutes had been reduced to standard atmospheric pressure, the resulting volume was taken as a measure of the amount of catalase in the gram of material. The material was shaken in a shaking machine at a fixed rate of 180 double shakes per minute during the determinations. It was found that the catalase of all the tissues of the diabetic dogs was decreased, the greatest decrease being in the heart and liver. The catalase of the heart was decreased by about 48 per cent. while that of the liver was decreased by about 72 per cent.

*"Surgical Shock."*—The condition of shock" was produced in cats and dogs by handling and manipulating the intestines. It was found that as the blood pressure decreased and the condition of "shock" developed, there was an accompanying decrease in the catalase of the blood, and that when the condition of "shock" was fully developed as was indicated by a fall in blood pressure to approximately 30 mm. of mercury, the catalase had decreased about 40 per cent. from the normal. Henderson observed that oxidation was decreased in "surgical shock" with resulting acidosis. Cannon has shown that in man in conditions of traumatic shock there is a condition of acidosis which is relieved by injections of solutions of sodium bicarbonate.

*Anesthesia.*—The anesthetics used were ether, chloroform, chloral hydrate, nitrous oxide, and magnesium sulfate. The animals used were cats, dogs, and rabbits. The ether and chloroform were administered by bubbling air through the respective anesthetics in a bottle, which was connected by a rubber tube to a cone adjusted over the snout of the animal. Chloral hydrate anesthesia was produced by the introduction into the stomachs of rabbits of 10 c.c. of a 2 per cent. solution of chloral hydrate per kilo of body weight. A mixture of nitrous oxide and oxygen in the poportion of one to five was administered to cats in the production of nitrous oxide anesthesia, while magnesium sulfate anesthesia was produced by the subcutaneous injection of 7.5 c.c. of a 20 per cent. magnesium sulfate solution per kilo of body weight. It was found that the catalase of the blood was decreased by all of these anesthetics and that the extent of the decrease was proportional to the depth of anesthesia. Chloroform and nitrous oxide, in keeping with their rapid action as anesthetics, decreased the catalase of the blood very quickly, whereas chloral hydrate and magnesium sulfate, in keeping with their slower action, decreased the catalase much more slowly, while ether occupied an intermediate position in this respect. It is recognized that there is a decrease in oxidation with resulting acidosis in anesthesia and that this is more likely to occur with a powerful anesthetic, such as chloroform, than with ether.

*Starvation.*—Four rabbits were used in this experiment. Two of them were killed before the period of starvation was begun, and after washing the blood vessels free of blood, the catalase of the different tissues was determined according to the method described in this paper under "diabetes." The remaining two rabbits were starved for six days, and at the end of this time the catalase of the tissues was determined in the same manner as that of the unstarved rabbits. It was found that the catalase of the voluntary muscles was decreased during starvation by 40 per cent.; that of the fat by 70 per cent.; while it remained normally high in the heart.

The conclusion is drawn that the defective oxidation in diabetes and the decreased oxidation in anesthesia, starvation, and "surgical shock"with resulting acidosis is propably due to the decrease in catalase, an enzyme found in the tissues and possessing the property of liberating oxygen from hydrogen peroxide.

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